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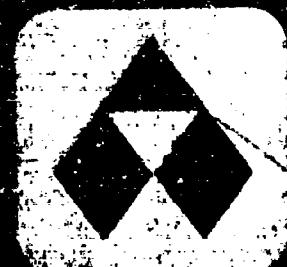
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MECHANICAL PROPERTIES, INCLUDING FRACTURE
TOUGHNESS AND FATIGUE, AND RESISTANCE TO
STRESS-CORROSION CRACKING OF STRESS-
RELIEVED STRETCHED ALUMINUM ALLOY EXTRUSIONS

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ABSTRACT

The tensile and some compressive, shear and bearing properties of a total of 90 samples of 2014, 2024, 6061, 7075 and 7178 aluminum alloy extrusions in the TX51X temper have been determined. The extrusions ranged in thicknesses from 0.051 in. to 6.500 in. Ratios among these properties have also been computed.

Stress-corrosion tests of 18 samples of TX51X extrusions have been initiated.

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THIRD QUARTERLY REPORT

MECHANICAL PROPERTIES, INCLUDING FRACTURE TOUGHNESS AND FATIGUE, AND RESISTANCE TO STRESS-CORROSION CRACKING OF STRESS-RELIEVED STRETCHED ALUMINUM ALLOY EXTRUSIONS

I. Introduction.

The tests being made under this contract are for use in establishing design mechanical properties in MTL-HDBK-5A, including stress-strain and tangent-modulus curves, for 2014, 2024, 6061, 7075, 7079 and 7178 aluminum alloy extrusions in the TX51X tempers. For comparison, limited similar tests are being made of extrusions in the "heat-treated-by-user" temper. Also, some fracture-toughness, axial-stress fatigue and stress-corrosion tests are being made.

This Third Quarterly Report summarizes the results of tensile and some compressive, shear, bearing and stress-corrosion tests made to date on 90 samples of the various alloys in the TX51X temper. The samples ranged in thickness from 0.051 to 6.500 in.

II. Material.

A total of 92 samples of commercially-produced extrusions in the TX51X temper and 14 samples in the O temper have been received from two producers. The section thickness and identification of each sample is shown in Table I. Twelve of the samples in the O temper have been heat treated or heat treated and aged in accordance with applicable conditions in Mil-H-6088D.

III. Procedure.Mechanical Properties

Tensile, compressive, shear and bearing specimens were taken at locations described in the Second Quarterly Report, dated September 15, 1966. The general dimensions of these specimens were shown in Figs. 1 to 3 inclusive of the Second Quarterly Report; the testing procedures are as outlined in the First Quarterly Report, dated June 15, 1966.

Some fracture toughness, axial-fatigue and tensile and compressive modulus specimens have been machined. Procedures for testing the fracture toughness and fatigue specimens are described in the First Quarterly Report.

The tensile and compressive specimens to be used for the modulus and stress-strain tests are as shown in Figs. 1 and 2. In all tests of longitudinal tensile specimens, strains will be measured over a 6-in. gage length with an Amsler-Martens mirror-type extensometer. In most of the tests of transverse tensile specimens it will be necessary to use smaller specimens and measure strains over a 4-, 2- or 1-in. gage length. The Amsler-Martens mirror-type extensometer will be used to measure strains over 4- and 2-in. gage lengths; the Tuckerman optical strain gage will be used for the 1-in. gage length. In all compressive tests, the Tuckerman optical strain gage will be used (2- or 1-in. gage length). The Amsler-Martens extensometer over the 6-in. gage length is probably ASTM Class A; over the 4-in. and 2-in. gage length it is an ASTM Class B-1. The Tuckerman extensometer is an ASTM Class A.

3.

Resistance to Stress Corrosion

Stress-corrosion tests were initiated with specimens from 18 samples of TX51X extrusions. Additional samples were selected for corrosion testing, 6 in the TX51X temper and 7 in the heat-treated-by-user or heat-treated-and-aged-by-user temper. Test specimens were machined from these samples and these specimens will be stressed to the desired levels after determination of appropriate tensile properties. The specimens used and the procedures followed are as described in the First Quarterly Report.

IV. Summary.

The results of tensile and some compressive, shear and bearing tests of 90 samples of extrusions in the TX51X temper are as shown in Table II. The tensile properties of all samples exceed the applicable specified minimum values as shown in Table III.

The ratios among the tensile, compressive and shear properties are as shown in Table IV. The ratios among the bearing and tensile properties are as shown in Table V. The ratios among the properties at different locations with regard to width and thickness are as shown in Table VI. The ratios among bearing properties obtained using edgewise specimens to those using flatwise specimens, are shown in Table VII.

The current status of the stress-corrosion tests is given in Table VIII. Preliminary test results show that stress-corrosion cracking has occurred only among specimens from the

2024-T3510 and 7075-T6510 alloy extrusions. Although tests have thus far progressed for a maximum period of only 30 days, these results indicate typical performance of the various materials.

For the same alloy and temper, there sometimes is considerable scatter among certain stresses or ratios of certain stresses. In some cases, it is obvious that there is a trend with thickness. However, trends may also be dependent on other variables, but until a larger percentage of the total number of samples has been tested, it does not seem desirable to try to analyze this situation thoroughly.

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V. Tables and Figures.

SAMPLES OF HISTOCYTIC REACTIVITY IN THE BRAIN 15, 1986

2025	2024				2023				2022				2021				
	Section	ARC	Thickness, Sample Number	Temper	Section	ARC	Thickness, Sample Number	Temper	Section	ARC	Thickness, Sample Number	Temper	Section	ARC	Thickness, Sample Number	Temper	
	in.	in.	in.	in.		in.	in.	in.		in.	in.	in.		in.	in.	in.	
-0	0.195	318121*	0.064	318026*	-0	0.067	317855	0.101	-T6510	0.075	318132*	0.075	-T6510	0	0.063	318024*	
0.099	315081	0.430	318135*	-T6510	0.075	318019*	0.094	318022*	0.101	317895	0.106	317904*	0.125	317947	1.625	0.126	317901
0.061	317295	0.100	318017*	-T6510	0.075	318019*	0.094	318022*	0.101	317895	0.120	317904*	0.150	317947	0.050	0.126	317905
0.073	311951	0.246	318130*	-T6510	0.075	318019*	0.094	318022*	0.101	317895	0.125	317904*	0.175	317947	0.050	0.126	317906
0.250	316154	0.271	311994	-T6511	0.106	317904*	0.120	317904*	0.120	317895	0.125	317904*	0.175	317948	0.125	0.126	317907
0.265	317952	0.275	317924	-T6510	0.151	317926	0.151	317926	0.151	317895	0.150	317926	0.175	317948	0.125	0.126	317908
0.750	316046	1.157	316046	-T6510	0.255	317945	0.255	317945	0.255	317895	0.250	317945	0.275	317948	0.125	0.126	317909
0.250	316154	0.271	316046	-T6510	0.255	317945	0.255	317945	0.255	317895	0.250	317945	0.275	317948	0.125	0.126	317910
0.271	317952	0.275	317924	-T6511	0.375	317943	0.375	317943	0.375	317895	0.375	317943	0.375	317948	0.125	0.126	317911
0.286	317952	0.275	317924	-T6510	0.520	317926	0.520	317926	0.520	317895	0.520	317926	0.520	317948	0.125	0.126	317912
1.157	316046	1.157	316046	-T6510	0.550	317856	0.550	317856	0.550	317895	0.550	317856	0.550	317948	0.125	0.126	317913
0.250	316154	0.271	316046	-T6510	0.642	317945	0.642	317945	0.642	317895	0.642	317945	0.642	317948	0.125	0.126	317914
0.271	317952	0.275	317924	-T6511	0.952	317943	0.952	317943	0.952	317895	0.952	317943	0.952	317948	0.125	0.126	317915
0.286	317952	0.275	317924	-T6510	1.250	317943	1.250	317943	1.250	317895	1.250	317943	1.250	317948	0.125	0.126	317916
1.157	316046	1.157	316046	-T6510	1.450	317943	1.450	317943	1.450	317895	1.450	317943	1.450	317948	0.125	0.126	317917
0.250	316154	0.271	316046	-T6510	2.150	317943	2.150	317943	2.150	317895	2.150	317943	2.150	317948	0.125	0.126	317918
0.271	317952	0.275	317924	-T6511	2.450	317943	2.450	317943	2.450	317895	2.450	317943	2.450	317948	0.125	0.126	317919
0.286	317952	0.275	317924	-T6510	2.750	317943	2.750	317943	2.750	317895	2.750	317943	2.750	317948	0.125	0.126	317920

* Producer E; all others from Producer A

TABLE II
MECHANICAL PROPERTIES OF STRESS-RELIEVED STANDARD SPECIMEN ALUMINUM EXTRUSIONS
[AR3(615)-3580]

Alloy and Temper	Sample Number	Section Thickness, in.	Loca- tion, Number	Dirac- tion, T/2	Ultimate Tensile Stress, psi	Yield Stress, psi	Elonga- tion, in. or %	Comp. Yield Stress, psi	Shear Ultimate Stress, psi	Yield Stress, psi	Plastic		Ultimate Stress, psi	Yield Stress, psi	
											Ultimate Stress, psi	Yield Stress, psi			
2014-T6510	0.061	317950	T/2	L	67 100	62 200	9.0 ***	64 600	—	105 600	138 800	88 200	103 900	—	—
	0.070	3180174	T/2	L	74 700	68 600	9.5 ***	62 800	—	104 500	134 900	88 500	105 800	—	—
0.075	317951	T/2	L	L	68 800	61 900	10.5 ***	62 800	—	—	—	—	—	—	—
0.271	3181304	T/2	L	L	67 100	59 400	10.0 ***	63 400	47 200	106 900	139 500	92 400	108 000	—	—
0.625	317952	T/2	L	L	67 700	62 800	10.5 ***	68 700	44 700	110 000	142 800	95 600	106 200	—	—
0.750	317952	T/2	L	L	67 700	62 800	10.5 ***	68 700	42 800	105 700	135 800	88 000	105 100	—	—
1.657	318046	T/4	L	L	70 300	71 500	10.5 ***	61 500	41 500	105 700	132 500	85 700	93 700	—	—
2024-T3510	0.075	3181324	T/2	L	65 900	53 100	18.0 ***	57 800	—	97 200	127 800	77 900	92 300	—	—
	0.094	3180194	T/2	L	65 900	52 100	15.5 ***	55 800	45 200	102 500	125 900	76 200	80 000	—	—
0.100	317985	T/2	L	L	65 900	52 100	15.5 ***	55 800	45 200	101 900	125 500	77 200	80 000	—	—
0.100	317985	T/2	L	L	65 900	52 100	15.5 ***	55 800	45 200	102 500	125 500	76 500	91 200	—	—
0.151	317986	T/2	L	L	65 900	52 100	15.5 ***	55 800	45 200	106 200	124 100	74 700	85 000	—	—
0.255	317942	T/2	L	L	70 700	62 100	19.0 ***	61 800	42 200	105 300	132 100	61 000	88 000	—	—
0.268	318047	T/2	L	L	70 700	62 100	19.0 ***	61 800	42 200	106 200	132 200	61 200	88 000	—	—
0.375	317943	T/2	L	L	70 700	62 100	19.0 ***	61 800	41 600	106 200	134 400	75 900	107 700	—	—
0.510	317926	T/2, 1/4	L	L	70 700	62 100	19.0 ***	60 000	50 000	100 600	130 600	77 400	94 800	—	—
0.525	3180205	T/2, 1/4	L	L	70 700	62 100	19.0 ***	60 000	52 500	102 200	132 200	75 900	92 500	—	—
0.526	317956	T/2, 1/4	L	L	70 700	62 100	19.0 ***	60 000	47 300	102 000	118 900	74 400	87 900	—	—
0.612	317945	T/2, 1/4	L	L	70 700	62 100	19.0 ***	60 000	47 300	105 100	130 700	73 500	97 300	—	—
0.950	317944	T/2, 1/4	L	L	70 700	62 100	19.0 ***	60 000	40 400	100 800	128 100	76 700	92 200	—	—
1.150	318077	T/2, 1/4	L	L	70 700	62 100	19.0 ***	60 000	39 700	102 400	132 200	75 900	92 500	—	—
1.200	317946	T/2, 1/4	L	L	70 700	62 100	19.0 ***	60 000	40 400	105 500	134 300	85 400	92 200	124 200	75 600

(continued)

TABLE II

TABLE II
 (Continued)
MECHANICAL PROPERTIES OF STRESS-RELIEVED AND ANNEALED ALUMINUM ALLOY EXTRUSIONS
 A75(615)-356

Alloy and Temper	Section Thickness, in.	Loca- tion Number	Dens- ity†	Tensile Yield Stress, psi	Elongation in in. or in. %	Tensile		Ultimate Stress, psi		Ultimate Stress, psi		Tensile			
						Comp. Field Stress, psi	Shear Ultimate Stress, psi	Ultimate Stress, psi	Ultimate Stress, psi	Ultimate Stress, psi	Ultimate Stress, psi	Ultimate Stress, psi	Ultimate Stress, psi		
2024-T5511	1.450	3180215 T/2,W/4	1.14	68,400	3.5	58,100	40,000	105,100	132,200	77,400	92,600	101,900	151,100	75,200	90,700
		3180216 T/2,W/4	1.14	68,800	3.5	58,100	39,700	104,200	129,300	76,500	91,200	100,600	127,600	72,600	90,100
		3180217 T/2,W/4	1.14	68,100	3.5	58,200	—	—	—	—	—	—	—	—	—
2024-T5510	2.520	3180335 T/2,W/4	1.14	67,000	4.0	57,900	40,900	94,000	118,100	73,400	88,200	94,600	122,100	72,200	88,000
		3180448 T/2,W/2	1.14	67,800	4.0	57,900	37,500	93,600	116,200	73,800	89,900	94,100	121,100	74,100	90,400
		3180449 T/2,W/2	1.14	67,100	4.0	57,900	37,700	91,800	115,200	72,900	89,700	—	—	—	—
2024-T6510	2.760	3180448 T/4,W/4	1.14	67,000	4.0	57,900	40,000	—	—	—	—	—	—	—	—
		3180449 T/2,W/2	1.14	67,800	4.0	57,900	39,700	94,000	118,100	73,400	88,200	94,600	122,100	72,200	88,000
		3180450 T/2,W/2	1.14	67,100	4.0	57,900	37,700	93,600	116,200	73,800	89,900	94,100	121,100	74,100	90,400
2024-T65210	0.075	3180225 T/2	1.14	72,400	4.0	68,400	70,000	—	—	—	—	—	—	—	—
	0.094	3180345 T/2	1.14	72,500	4.0	68,600	73,300	—	—	—	—	—	—	—	—
	0.101	3180347 T/2	1.14	72,500	4.0	68,600	73,500	—	—	—	—	—	—	—	—
0.106	0.106	3180346 T/2	1.14	72,500	4.0	68,600	73,500	—	—	—	—	—	—	—	—
	0.120	3180235 T/2	1.14	72,500	4.0	68,600	73,500	—	—	—	—	—	—	—	—
	0.151	317889 T/2	1.14	72,500	4.0	68,600	73,500	—	—	—	—	—	—	—	—
0.255	0.255	317890 T/2	1.14	72,500	4.0	68,600	73,500	—	—	—	—	—	—	—	—
	0.258	318082 T/2	1.14	72,500	4.0	68,600	73,500	—	—	—	—	—	—	—	—
	0.375	317891 T/2	1.14	72,500	4.0	68,600	73,500	—	—	—	—	—	—	—	—
0.510	0.510	317892 T/2,W/2	1.14	72,500	4.0	68,600	73,500	—	—	—	—	—	—	—	—
	0.505	3180245 T/2,W/4	1.14	72,500	4.0	68,600	73,500	—	—	—	—	—	—	—	—
	0.950	317922 T/2,W/4	1.14	72,500	4.0	68,600	73,500	—	—	—	—	—	—	—	—
0.550	0.550	317922 T/2,W/4	1.14	72,500	4.0	68,600	73,500	—	—	—	—	—	—	—	—
	0.642	317924 T/2,W/4	1.14	72,500	4.0	68,600	73,500	—	—	—	—	—	—	—	—
	0.950	317923 T/2,W/4	1.14	72,500	4.0	68,600	73,500	—	—	—	—	—	—	—	—

(Continued)

TABLE II
 (Continued)
MECHANICAL PROPERTIES OF STRESS-RELIEVED ALUMINUM ALLOY EXTRUSIONS
 A73(6.5)-5580

Alloy and Temper	Sample Number	Section thickness, in.	Loca- tion, Direction [†]	Tensile Ultimate Stress, psi	Elongation at 2 in. or 4 in. %	Comp. Field Stress, psi	Spear Ultimate Stress, psi	Plastic		Plastic		Ultimate Stress, psi	Yield Stress, psi		
								Ultimate Stress, psi		Ultimate Stress, psi					
								σ_{UTS} σ_{SUS}	σ_{PSL}	σ_{UTS} σ_{SUS}	σ_{PSL}				
2024-T6510	1.150	318078	T/2,W/4	66	200	66	200	8.5	—	106	900	92	900		
			E/2,W/2	66	200	66	200	8.5	—	106	900	92	900		
			T/2,W/4	71	200	71	200	7.5	—	106	900	92	900		
2024-T8511	1.200	317895	T/2,W/4	71	200	71	200	7.5	—	106	900	92	900		
			T/2,W/4	71	200	71	200	7.5	—	106	900	92	900		
			T/2,E/2	71	200	71	200	7.5	—	106	900	92	900		
2024-T8510	1.450	318025	T/2,W/4	71	200	71	200	7.5	—	106	900	92	900		
			T/2,W/2	71	200	71	200	7.5	—	106	900	92	900		
			T/2,W/4	71	200	71	200	7.5	—	106	900	92	900		
			T/2,E/2	71	200	71	200	7.5	—	106	900	92	900		
6061-T6510	0.050	318136	T/2	40	400	40	400	—	—	74	200	66	800		
	0.075	317857	T/2	42	300	42	300	—	—	69	100	40	800		
	0.090	318027	T/2	42	300	42	300	—	—	70	900	70	200		
	0.125	317846	T/2	42	300	42	300	—	—	70	900	70	200		
	0.126	317847	T/2	42	300	42	300	—	—	70	900	70	200		
	0.250	317846	T/2	42	300	42	300	—	—	70	900	70	200		
	0.310	317905	T/2	42	300	42	300	—	—	70	900	70	200		
	0.315	317953	T/2	42	300	42	300	—	—	70	900	70	200		
	C.375	317927	T/2	42	300	42	300	—	—	70	900	70	200		
	0.375	318083	T/2	42	300	42	300	—	—	70	900	70	200		
	C.318	317906	T/2,W/2	42	300	42	300	—	—	70	900	70	200		
	-1.240	317907	T/2,W/4	42	300	42	300	—	—	70	900	70	200		
	1.950	*317896	T/2,W/4	42	300	42	300	—	—	70	900	70	200		
	6.500	317897	T/4	42	300	42	300	—	—	70	900	70	200		
			T/2	42	300	42	300	—	—	70	900	70	200		

(Continued)

TABLE II
 (Continued)
MECHANICAL PROPERTIES OF STRESS-STRENGTHENED AND ANNEALED ALLOY TESTS
 [A735(65)-580]

Alloy and Temper	Section Thickness, in.	Loca- tion Number	Dir- ection	Tensile Ultimate Stress, psi	Tensile Elongation at Break, * in. or in. per in.	Comp. Field Stress, * psi	Shear Ultimate Stress, psi	Properties		
								Ultimate Stress, psi	Total Strain, $\epsilon/10^{-3}$	$\sigma/\sigma_{UTS} \cdot 10^2$
T075-T650	0.065	317699	T/2	170000	79.200	11.0	75400	126600	106900	125100
	0.065	3176911	T/2	170000	77.700	10.5***	77300	128700	109300	125100
0.08C	317698	T/2	170000	81.500	12.0	70500	129900	109600	125300	
0.125	317691	T/2	170000	75.800	9.0	70500	129200	107800	125500	
0.160	317696	T/2	170000	72.400	15.0***	70500	128800	108600	125600	
0.260	317693	T/2	170000	78.500	15.0***	78800	126500	104800	125400	
0.312	317696	T/2	170000	79.400	15.0***	85300	125400	104400	125600	
0.375	317694	T/2	170000	79.200	15.0***	82200	125100	104100	125600	
0.438	317699	T/2	170000	80.400	15.0***	89600	125100	104200	125600	
0.462	318022	T/2	170000	85.700	15.0***	95900	125100	104400	125600	
1.022	3180218	T/2,W/4	170000	76.400	10.0	70500	125100	108800	125100	
1.188	317686	T/2,W/4	170000	76.200	10.0	70500	125100	108800	125100	
1.500	3176955	T/2,W/2	170000	77.400	10.0	70500	125100	108800	125100	
2.000	317861	T/2	170000	76.100	10.0	70500	125100	108800	125100	
2.190	3181375	T/4,W/4	170000	79.100	10.0	70500	125100	108800	125100	
3.040	3181365	T/4,W/4	170000	78.400	10.5	70500	125100	108800	125100	
7.275-T35C	0.280	317362	T/2	75400	6.6700	18.2	69400	142300	113400	125300
C.313	317903	T/2	75400	75400	6.0	78400	142300	113400	125300	
C.375	317906	T/2	75400	75400	6.0	78400	142300	113400	125300	
C.438	317910	T/2	75400	77600	6.0	69800	142400	113400	125300	

(Continued)

TABLE II Sheet 4 (Continued)

TABLE III
SPECIFIED MINIMUM VALUES FOR ALUMINUM ALLOY EXTRUSIONS TESTED
[AF 33(615)-3580]

Alloy and Temper	Thickness, in.	Area, sq in.	Ultimate Tensile Stress, psi	Yield Stress,* psi	2 in. or 4D, %	Elongation 2 in.	Federal Specification
2014-T6510	≤ 0.499 $0.500-0.749$ ≥ 0.750	All All ≥ 25	60 000 64 000 68 000	53 000 58 000 60 000	7 7	7	QQ-A-200, 2b
2024-T3510, -T3511	≤ 0.249 $0.250-0.749$ $0.750-1.499$ ≤ 1.500 ≥ 1.500	All All All ≥ 25 $\geq 25, \leq 32$	57 000 60 000 65 000 70 000 68 000	42 000 44 000 46 000 52 000 48 000	12 12 10 10	12	QQ-A-200, 3b
-T8510, -T8511	$0.050-0.249$ $0.250-1.499$ ≥ 500	All All ≥ 32	64 000 66 000 66 000	56 000 58 000 58 000	4 5	5	QQ-A-200, 6b
6061-T6510	All	All	38 000	35 000	10	10	QQ-A-200, 11b
7075-T6510	≤ 0.249 $0.250-0.499$ $0.500-2.999$ $3.000-4.499$	All All All ≥ 20	78 000 81 000 81 000 81 000	70 000 73 000 72 000 71 000	7 7 7 7	7	None
-T73510	≤ 0.249 $0.250-0.499$ $0.500-2.999$	— — —	— — —	— — —	— — —	— — —	QQ-A-200, 13
7178-T6510	≤ 0.249 $0.250-1.499$ $1.500-2.999$	All All All	85 000 88 000 85 000	78 000 79 000 78 000	5 5 5	5	

* Offset equals 0.2 per cent.

TABLE IV
**RATIOS AMONG THE TENSILE, COMPRESSIVE AND SHEAR PROPERTIES
 OF STRESS-RELIEVED STRETCHED ALUMINUM ALLOY EXTRUSIONS**
 [ASTM (615)-7580]

Alloy and Tempor	Sample Number	Section Thickness, in. Number	Location*	$\frac{F_{T}}{F_{C}}$	$\frac{F_{T}}{F_{S}}$	$\frac{F_{C}}{F_{T}}$	$\frac{F_{S}}{F_{T}}$	$\frac{F_{S}}{F_{C}}$	$\frac{F_{S}}{F_{S}}$
2014-T6510	0.061 0.070 0.075 0.245 0.271 0.625 0.756 1.657	310250 310217 310270 310247 310294 310224 310246	T/2 T/2 T/2 T/2 T/2 T/2 T/2	1.10 — 1.11 — 1.06 — 0.92 — 0.91	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —
2024-T6510	0.075 0.101 0.106 0.151 0.255 0.258 0.275 0.510 0.525	310232† 310285 310204 310218† 310242 310247 310243 310226 310207	T/2 T/2 T/2 T/2 T/2 T/2 T/2 T/2 T/2	1.07 — — — — — — — —	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —
2024-T6511	1.450 2.520 2.760	310232† 310232† 310248	T/2 T/2 T/2	— — —	— — —	— — —	— — —	— — —	— — —
2024-T6510	2.000 1.450 2.520 2.760	310246 310221† 310232† 310248	T/2 T/2 T/2 T/2	— — — —	— — — —	— — — —	— — — —	— — — —	— — — —
2024-T6510	0.075 0.101 0.106 0.151 0.255 0.258 0.275 0.510 0.525	310222† 310287 310288 310222† 310289 310290 310282 310291 310224†	T/2 T/2 T/2 T/2 T/2 T/2 T/2 T/2 T/2	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —
2024-T6510	0.075 0.101 0.106 0.151 0.255 0.258 0.275 0.510 0.525	310222† 310287 310288 310222† 310289 310290 310282 310291 310224†	T/2 T/2 T/2 T/2 T/2 T/2 T/2 T/2 T/2	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —	— — — — — — — — —

TABLE IV

(Continued)

TABLE IV
 (Continued)
**RATIOS AMONG THE TENSILE, COMPRESSIVE AND SHEAR PROPERTIES
 AT TESTED ALLOY-TEMPER ALUMINUM ALLOY EXTRUSIONS**
 [ASME (G15)-5580]

Alloy and Temper	Sample	Section Thickness in. Number	Location*	Tensile Strength		Compressive Strength		Shear Strength	
				MPa (psi)	Msi (psi)	MPa (psi)	Msi (psi)	MPa (psi)	Msi (psi)
2024-T851C	217932 217934 218078	1.25C 1.45C 2.76C	E/2, V/2 E/2, V/2 E/2, V/2	317.85 317.85 318.079	45.000 45.000 45.000	317.857 317.857 317.857	45.000 45.000 45.000	317.85 317.85 317.85	45.000 45.000 45.000
2024-T851C	C-55C C-55C	1.25C 1.45C	E/2, V/2 E/2, V/2	318.064 318.064	45.000 45.000	318.064 318.064	45.000 45.000	318.064 318.064	45.000 45.000
6061-T651C	C-55C C-55C	1.25C 1.45C	E/2, V/2 E/2, V/2	318.064 318.064	45.000 45.000	318.064 318.064	45.000 45.000	318.064 318.064	45.000 45.000
TOTALS									

TABLE IV Sheet 2 (Continued)

(Continued)

TABLE IV
(Concluded)
RATIOS AMONG THE TENSILE, COMPRESSIVE AND SHEAR PROPERTIES
OF STRESS-RELIEVED STRENGTHENED ALUMINUM ALLOY EXTRUSIONS
[AF3(615)-3550]

Alloy and Temper	Section Thickness, in.	Number	Location*	$\frac{TS(E)}{TS}$		$\frac{TS(S)}{TS}$		$\frac{TS(T)}{TS}$		$\frac{CS(E)}{TS}$		$\frac{CS(S)}{TS}$		$\frac{CS(T)}{TS}$	
				TS(E)	TS(S)	TS(E)	TS(S)	TS(T)	CS(E)	CS(S)	CS(T)	CS(S)	CS(T)	CS(S)	CS(T)
7075-T6510	1.198	317860	T/2, W/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
	1.500	317855	T/2, W/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
	2.000	317861	T/2, W/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
	2.190	318137*	T/4, W/4	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
7075-T73510	3.040	318138†	T/4, W/4	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
	3.232	317909	T/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
	0.715	317920	T/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
	1.500	317926	T/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
7178-T6510	2.000	317946	T/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
	0.865	317903	T/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
	0.132	318016	T/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
	0.154	318035†	T/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
7178-T6510	0.152	317902	T/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
	0.200	317995	T/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
	0.635	317997	T/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
	2.200	318139†	T/2, W/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
7178-T6510	1.436	317927	T/2	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97
	2.180	318140†	T/4, W/4	0.97	0.85	0.97	0.85	0.97	0.95	0.97	0.97	0.95	0.97	0.95	0.97

* = Thickness; W = Width
† = Producer B; all others from Producer A

TABLE IV Sheet 3 (Concluded)

TABLE V
RATIOS OF MEANING TO PREDICTED PROPERTIES OF STRESS-RELIEF DRUGS

(Continued)

TABLE V
 (Continued)
 RATIO'S OF BEARING TO TENSILE PROPERTIES OF STRESS-STRENGTHENED
 ALUMINUM ALLOY EXTENSIONS
 [AFS(615)-358]

Alloy and Temper	Sample Section Thickness, in.	Number	Location*	Plastic				Elastic				Plastic				Elastic			
				RAT-1.5	RAT-2.0	RAT-2.5	RAT-3.0												
2024-T5510	0.151	21789	E/2	1.27	2.03	3.12	4.16	1.76	1.47	1.88	1.41	1.66	1.35	1.35	1.35	1.35	1.35	1.35	1.35
	0.205	21790	E/2	1.45	2.19	3.25	4.37	1.82	1.52	1.93	1.47	1.71	1.41	1.41	1.41	1.41	1.41	1.41	1.41
	0.250	21791	E/2	1.57	2.32	3.42	4.57	2.01	1.71	2.02	1.56	1.82	1.51	1.51	1.51	1.51	1.51	1.51	1.51
	0.305	21792	E/2	1.67	2.42	3.52	4.67	2.11	1.81	2.12	1.66	1.92	1.65	1.65	1.65	1.65	1.65	1.65	1.65
	0.362	21793	E/2	1.75	2.52	3.62	4.75	2.21	1.91	2.22	1.76	2.07	1.79	1.79	1.79	1.79	1.79	1.79	1.79
	0.416	21794	E/2	1.82	2.62	3.72	4.82	2.31	2.01	2.32	1.86	2.17	1.89	1.89	1.89	1.89	1.89	1.89	1.89
	0.475	21795	E/2	1.87	2.67	3.77	4.87	2.36	2.06	2.37	1.91	2.22	1.93	1.93	1.93	1.93	1.93	1.93	1.93
	1.200	217895	E/2	1.42	2.42	3.42	4.42	1.62	1.32	1.63	1.17	1.42	1.16	1.16	1.16	1.16	1.16	1.16	1.16
2024-T5511	1.45C	219025	E/2	1.64	2.64	3.64	4.64	1.76	1.46	1.77	1.31	2.01	1.70	1.70	1.70	1.70	1.70	1.70	1.70
	2.75C	213379	E/2	1.74	2.74	3.74	4.74	1.86	1.56	1.87	1.41	2.16	1.85	1.85	1.85	1.85	1.85	1.85	1.85
2024-T5512	2.75C	217857	E/2	1.69	2.69	3.69	4.69	1.80	1.50	1.81	1.45	2.10	1.79	1.79	1.79	1.79	1.79	1.79	1.79
	0.675	217858	E/2	1.75	2.75	3.75	4.75	1.85	1.55	1.86	1.40	2.15	1.84	1.84	1.84	1.84	1.84	1.84	1.84
	1.350	217859	E/2	1.81	2.81	3.81	4.81	1.91	1.61	1.92	1.46	2.19	1.88	1.88	1.88	1.88	1.88	1.88	1.88
	2.750	217860	E/2	1.86	2.86	3.86	4.86	1.96	1.66	1.97	1.51	2.24	1.95	1.95	1.95	1.95	1.95	1.95	1.95
	5.000	217861	E/2	1.91	2.91	3.91	4.91	2.01	1.71	2.02	1.56	2.29	1.98	1.98	1.98	1.98	1.98	1.98	1.98
	7.250	217862	E/2	1.96	2.96	3.96	4.96	2.06	1.76	2.07	1.61	2.34	2.05	2.05	2.05	2.05	2.05	2.05	2.05

(Continued)

TABLE V
(Continued)
RATIOS OF BEARING TO TENSILE PROPERTIES OF STRESS-RELIEVED STRENGTHENED ALUMINUM ALLOY EXTRUSIONS
TAF3 (GL5)-3580

Π - producer's price; N - width
Producer B; all others from Producer A

** Bearing specimen failed before reaching yield stress (2 per cent offset).
 Note: L = Longitudinal; LT = Long-Transverse

TABLE VI
RATIOS AMONG THE MECHANICAL PROPERTIES AT DIFFERENT LOCATIONS
[API 5 (615)-3580]

Alloy and Temper	Sample Number	Section Thickness, In.	Direction*	Location†	Tensile Ultimate Stress	Tensile Yield Stress	Compressive Yield Stress	Shear Ultimate Stress	Bearing‡	
									Ultimate Stress $e/D = 1.5$	Yield Stress $e/D = 2.0$
2014-T3510	1.657	318046	L	$\frac{1}{2} \times \frac{7}{4}$	1.01	1.01	1.01	1.00	0.99	0.97
2024-T3510	0.525	318C20**	L	$\frac{3}{4} \times \frac{7}{4}$	0.99	1.00	1.05	0.98	—	—
	1.150	318C77	LT	$\frac{3}{4} \times \frac{7}{4}$	1.05	1.02	—	—	—	—
2024-T3511	1.450	318021**	L	$\frac{3}{4} \times \frac{7}{4}$	0.97	0.96	0.94	1.01	0.99	0.98
	2.520	318133**	LT	$\frac{3}{4} \times \frac{7}{4}$	0.98	0.97	0.99	—	—	—
2024-T3510	2.760	318C48	L	$\frac{3}{4} \times \frac{7}{4}$	1.00	1.00	—	—	0.99*	0.99*
	0.525	318C24**	LT	$\frac{3}{4} \times \frac{7}{4}$	0.99	0.98	—	—	—	—
2024-T3510	1.150	318C25**	L	$\frac{3}{4} \times \frac{7}{4}$	1.00	1.01	—	—	—	—
	1.450	318025**	LT	$\frac{3}{4} \times \frac{7}{4}$	1.00	1.02	—	—	—	—
2024-T3510	2.760	318C79	L	$\frac{3}{4} \times \frac{7}{4}$	1.01	1.02	—	—	1.04	1.06
	0.525	318C24**	LT	$\frac{3}{4} \times \frac{7}{4}$	1.03	1.06	1.04	1.01	0.98*	0.98*
2024-T3510	1.150	318C25**	L	$\frac{3}{4} \times \frac{7}{4}$	0.99	0.98	—	—	0.99	0.97
	1.450	318025**	LT	$\frac{3}{4} \times \frac{7}{4}$	1.00	1.00	—	—	—	—
2024-T3511	2.520	318C79	L	$\frac{3}{4} \times \frac{7}{4}$	1.00	1.00	—	—	—	—
	2.760	318C79	LT	$\frac{3}{4} \times \frac{7}{4}$	1.00	1.00	—	—	—	—

(Continued)

TABLE VI

TABLE VI
[CONT'D.]
RATIOS AMONG THE MECHANICAL PROPERTIES AT DIFFERENT LOCATIONS

Alloy and Temper	Section Thickness, in.	Sample Number	Direction*	Location†	Tensile Strength		Compressive Strength	Ultimate Stress Stress	Ultimate Strength		Ultimate Stress Stress
					Ultimate Tensile Strength	Field Tensile Strength			Ultimate Tensile Strength	Field Tensile Strength	
6061-T6510	1.240	317907	L	1/4	1.01	1.01	0.98	0.99	—	—	—
	1.960	317896	L	1/4	1.01	1.01	1.02	0.96	1.00	1.00	0.97
	6.500	317897	L	1/4	0.99	0.99	0.99	0.99	0.98	0.98	0.95
7075-T6510	1.188	317866	L	1/4	0.95	0.97	0.97	0.97	—	—	—
	2.000	317861	L	1/4	0.98	—	0.98	0.99	—	—	—
	2.130	316137**	L	1/4	0.96	0.97	0.98	0.97	1.00	1.01	0.99
7075-T73510	2.000	317908	L	1/4	0.97	0.97	1.05	0.97	0.95	0.95	0.95
	0.625	317907	L	1/4	0.99	0.98	0.98	0.99	1.00	1.01	0.99
	1.200	316139**	L	1/4	0.98	0.98	0.98	0.98	—	—	—
7175-T6510	5.180	208140**	L	1/4	0.97	0.97	0.97	0.97	1.00	1.00	0.98
	—	—	L	1/4	—	—	—	—	—	—	—

* L = Longitudinal; LM = Long-Transverse

† thickness; L = flat

** Direct shear specimens; others - flatwise specimens
Producer B; all others from Producer A

TABLE VI Sheet 2 (Concluded)

TABLE VII

RATIOS OF BEARING PROPERTIES IN THE EDGEWISE DIRECTION TO THOSE IN THE FLATWISE DIRECTION FOR STRESS-RELIEVED STRETCHED ALUMINUM ALLOY EXTRUSIONS

Alloy and Temper	Section Thickness, in.	Sample Number	Location*	Direction†	Edgewise/Flatwise		
					BYS(E)/BYS(F) e/D=1.5	BYS(E)/BYS(F) e/D=2.0	BYS(E)/BYS(F) e/D=1.5 e/D=2.0
2024-T3510	1.150	318077	T/2, W/4	L	0.91	0.97	0.97
	1.200	317946	T/2, W/4	L	0.97	0.98	0.98
2024-T3511	1.450	318021‡	T/2, W/4	L	0.97	0.97	0.98
2024-T3510	2.760	318048	T/2, W/4	L	0.97	0.99	0.99
			T/4, W/2	L	0.94	0.96	0.97
2024-T8510	1.150	318078	T/2, W/4	L	0.87	0.93	0.95
	1.200	317895	T/2, W/4	L	0.95	0.97	0.97
2024-T8511	1.450	318025‡	T/2, W/4	L	0.96	0.96	0.96
2024-T8510	2.760	318079	T/2, W/4	L	0.96	0.98	0.98
			T/4, W/2	L	0.95	0.96	0.97
6061-T5510	1.240	317907	T/2, W/2	L	0.99	0.98	0.97
	1.960	317896	T/2, W/2	L	0.99	1.00	1.00
	6.500	317897	T/4	L	0.99	0.97	0.99
7075-T310	1.188	317860	T/2, W/4	L	0.86	0.93	0.90
			T/2, W/2	L	0.87	0.90	0.89
			T/2, W/2	L	0.88	0.95	0.93
			T/2, W/2	L	0.90	0.93	0.88
			T/2, W/2	L	0.90	0.93	0.92

* T - Thickness; W - Width.

† L - Longitudinal; LL - Long-Transverse

‡ Producer B; all others from Producer A

** Bearing specimen failed before reaching yield stress (2 per cent offset).

TABLE VIII

**RESISTANCE TO STRESS-CORROSION CRACKING OF STRESS-
RELIEVED STRETCHED ALUMINUM ALLOY EXTRUSIONS**

<u>Alloy</u>	<u>Section Thickness, In.</u>	<u>Sample Number</u>	<u>Strength*</u>					
			<u>Longitudinal F/N+ Days</u>	<u>75% F/N Days</u>	<u>Yield Strength F/N Days</u>	<u>Short Transverse F/N Days</u>	<u>Long Transverse F/N Days</u>	<u>Short Transverse F/N Days</u>
2024-T3510	0.255	317942	0/2	30	0/2	30	---	---
	0.510	317926	0/2	30	0/2	30	---	---
	0.950	317944++	0/2	30	0/2	30	2/2	6, 6
	1.200	317946++	0/2	30	2/2	7, 7	2/2	6, 6
2024-T8510	0.255	317890	0/2	30	0/2	30	---	---
	0.510	317892	0/2	30	0/2	30	---	---
	0.950	317893++	0/2	30	0/2	30	0/2	16
	1.200	317895++	0/2	30	0/2	30	0/2	16
6061-T6510	0.315	317953	0/2	30	0/2	30	---	---
	0.375	317927	0/2	30	0/2	30	---	---
	1.240	317907	0/2	30	0/2	30	---	---
	1.960	317896	0/2	30	0/2	30	---	---
7075-T6510	0.375	317954	0/2	30	1/2	17, 30	---	---
	0.438	317859	0/2	30	0/2	30	---	---
	1.188	317860++	0/2	30	0/2	30	2/2	6, 6
	1.188	317860++	0/2	30	0/2	30	---	---
7075-T73510	0.375	317900	0/2	30	0/2	30	---	---
	0.438	317910	0/2	30	0/2	30	---	---
7178-T6510	0.625	317997	0/2	30	0/2	30	---	---

Notes:

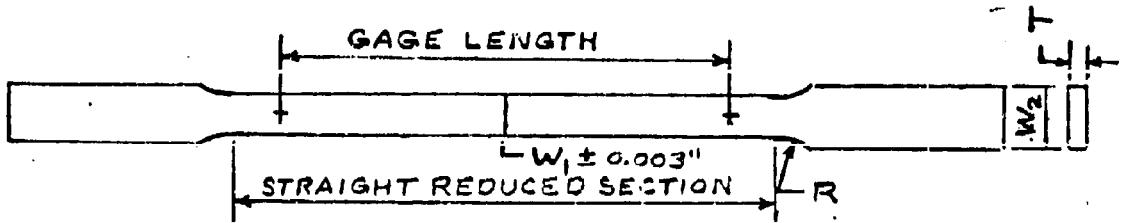
* Specimens used are described in the first Quarterly Report.

+ F/N denotes number of specimens failed over number exposed.

++ Short transverse yield strengths obtained by tests of duplicate 0.050" diameter tension specimens.

Yield

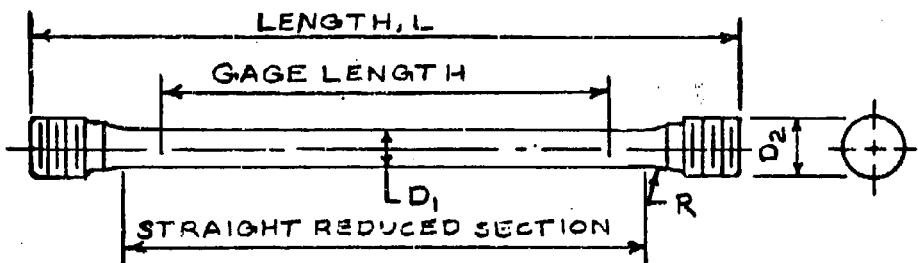
<u>s. - No.</u>	<u>Strength, psi</u>
317944	49 000
317946	48 200
317893	65 000
317895	65 700
317860	73 600



WIDTH, IN.		GAGE LENGTH, IN.	REDUCED SECTION LENGTH, IN.	RADIUS (R), IN.	THICKNESS (T), IN.
W ₁	W ₂	6.000 ± 0.002	7 *	7/8	≥ 0.499
0.500 ± 0.003	3/4	6.000 ± 0.002	7 *	7/8	≥ 0.499
0.250 ± 0.002	3/8	1.000 ± 0.002	1-1/2	3/8	≥ 0.250

* FOR SOME LONG-TRANSVERSE SPECIMENS, GAGE LENGTHS ARE 4 IN., REDUCED-SECTION LENGTHS ARE .5 IN.

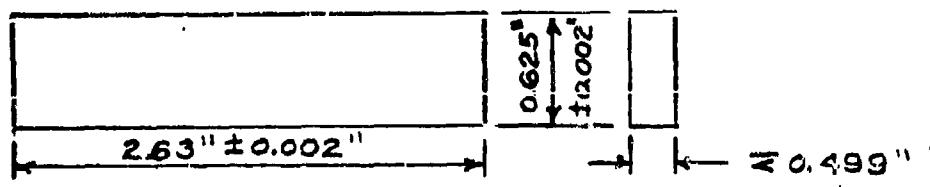
Sheet-Type Specimens



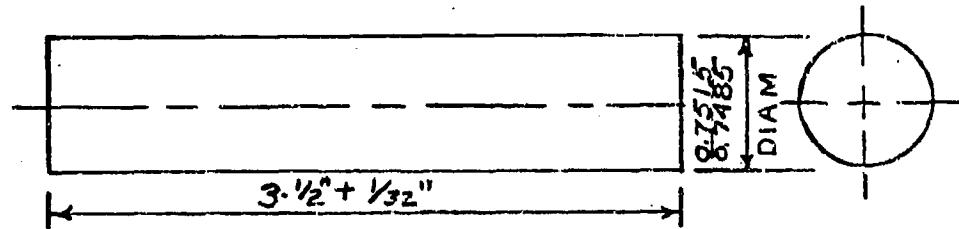
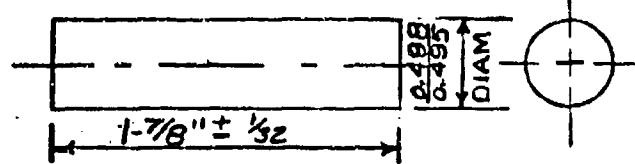
DIAMETER, IN.		GAGE LENGTH, IN.	REDUCED SECTION LENGTH, IN.	RADIUS (R), IN.	LENGTH (L), IN.
D ₁	D ₂	6.000 ± 0.002	7	5/8	9-1/2
0.500 ± 0.003	3/4	6.000 ± 0.002	7	5/8	9-1/2
0.500 ± 0.003	3/4	4.000 ± 0.002	5	5/8	7-1/2
0.500 ± 0.003	3/4	2.000 ± 0.002	3	5/8	5-1/2
0.438 ± 0.003	5/8	2.000 ± 0.002	2-7/8	5 D ₁	5-1/4
0.375 ± 0.003	9/16	2.000 ± 0.002	2-3/4	5 D ₁	.5

Round Specimens

Fig. 1 General Dimensions of Tensile Specimens For Modulus and Stress-Strain Tests



Sheet-Type Specimen



Round Specimens

**Fig. 2 General Dimensions of Compressive Specimens
For Modulus and Stress-Strain Tests**